

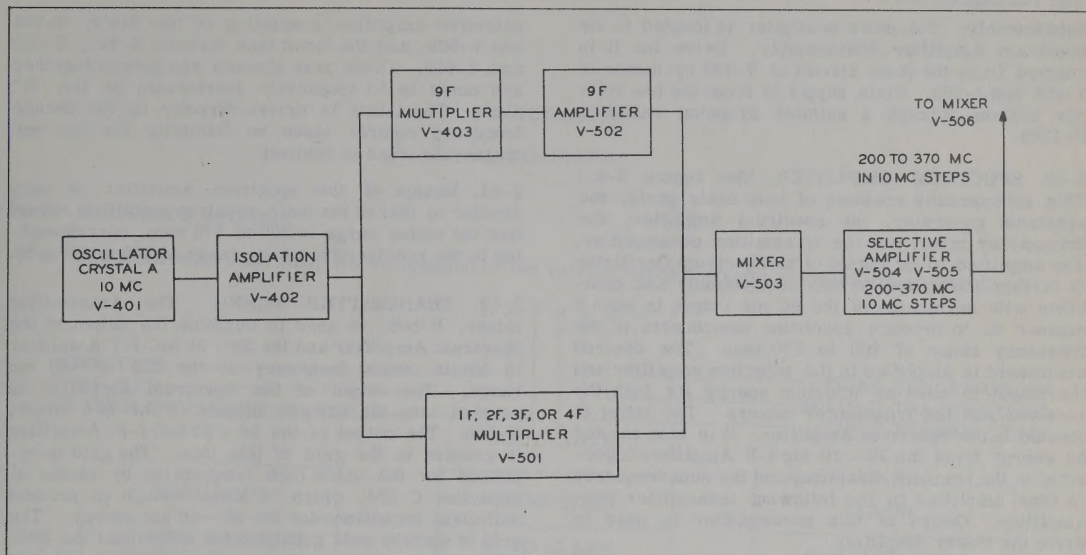


Figure 2-7. Receiver-Transmitter RT-178/ARC-27, Spectrum System, Block Diagram

bandwidths are approximately 100 and 325 kc respectively. Voltage from the avc line is applied to the grid of the amplifier tube V-805.

2-50. FINAL DETECTOR AND AUDIO. The final diode detector V-809A and the noise limiter V-808 are operated just as in the main channel receiver. Similarly V-810A serves as the avc rectifier for the avc amplifier V-810B, which in turn controls operation of the avc gate, V-809B. The squelch tube, V-811A, controls the gain of the audio amplifier tube V-811B. Audio from the latter is coupled through C-876 and R-393 to the grid of V-314A in the main channel IF and Audio Unit.

2-51. THEORY OF OPERATION OF SPECTRUM GENERATING SYSTEM.

2-52. GENERAL. (See figure 2-7.) The spectrum system, consisting of the Spectrum Oscillator and the Spectrum Amplifier, is used to provide injection voltage to the first mixer for the receiver and also in a similar conversion for the transmitter. Fundamentally a 10 mc crystal oscillator is multiplied to obtain harmonics in the range of 200 to 370 mcs. Selectivity is provided to reduce the strength of unwanted harmonics adjacent to the desired one.

2-53. SPECTRUM OSCILLATOR. (See figure 6-3.) This subassembly consists of a highly stable crystal oscillator followed by an isolation amplifier and a multiplier stage. Output from the subassembly is coupled to the Spectrum Amplifier by means of concentric plugs.

2-54. The crystal oscillator consists of a 6AG5

pentode, V-401, in an electron coupled oscillator circuit. The crystal itself is in a HC-6 holder mounted in an oven thermostatically controlled to a temperature of 80°C (176°F). At -55°C (-67°F) ambient this holder is capable of providing proper operating temperature in less than ten minutes. The oscillator section consists of the grid, cathode and screen of the pentode in a Colpitts oscillator circuit. The capacitors C-402 and C-403 are used as the voltage divider. The capacitor C-401 is used to adjust the total capacitance between grid and ground to 32 mmf, which is standard for this crystal. This capacitor is an adjustable element which may be set initially for the correct capacitance and later trimmed slightly to adjust the oscillator frequency to exactly 10 mcs. The latter may be accomplished by comparison to a more precise standard such as WWV. The plate circuit of the oscillator is untuned to increase circuit stability. Overall instability resulting from temperature, tube and aging effects is less than 0.001% which is the requirement of this section of the equipment to meet an overall performance figure of 0.0015%.

2-55. Output from the crystal oscillator is coupled to the grid circuit of a buffer-amplifier to further isolate the crystal oscillator circuit from effects of tuned circuits. This stage consists of a 6AG5, V-402, operated as a Class A amplifier. The plate circuit of this stage is tuned to 10 mcs and coupled to two following multipliers. One multiplier, V-403, is located in this subassembly. It utilizes a 6AG5 operated as a Class C frequency multiplier, multiplying 9 times. The output circuit is therefore tuned to 90 mcs and coupled by means of concentric connector J-401 and J-501 to the following Spectrum Amplifier

Subassembly. The other multiplier is located in the Spectrum Amplifier Subassembly. Drive for it is coupled from the plate circuit of V-402 by means of J-402 and J-502. Plate supply is from the low voltage system through a suitable dropping resistor, R-1505.

2-56. SPECTRUM AMPLIFIER. (See figure 6-4.) This subassembly consists of four basic parts, the spectrum generator, the spectrum amplifier, the transmitter mixer and the transmitter preamplifier. The amplified 10 mc output of the Spectrum Oscillator is further multiplied in this subassembly and combined with harmonics of the 90 mc output in such a manner as to produce spectrum components in the frequency range of 200 to 370 mcs. The desired component is amplified in the selective amplifier and the output is used as injection energy for both the receiver and the transmitter mixers. The latter is located in the Spectrum Amplifier. It is also excited by energy from the 20 - 30 mc I-F Amplifier (operating in the transmit direction) and the sum frequency is then amplified in the following transmitter preamplifier. Output of this preamplifier is used to drive the Power Amplifier.

2-57. SPECTRUM GENERATOR. The spectrum generator consists of the three tubes V-501, V-502 and V-503. The first, V-501, is a 6AG5 pentode operated as a Class C harmonic generator. The grid circuit is excited by 10 mc energy from the isolation amplifier, V-402. The plate circuit has four circuits fixed-tuned to 10, 20, 30 and 40 mcs. The desired circuit is chosen by the corresponding relays K-501, K-502, K-503 and K-504. The output of this stage is coupled to the cathode of the mixer tube, V-503.

2-58. The second tube, V-502, is driven by 90 mc energy from V-403 and is operated as an amplifier with its plate circuit consisting of C-507 and L-505 also tuned to 90 mcs. Output from this stage is coupled to the grid of the mixer tube, V-503.

2-59. The third tube, V-503, is used as a mixer tube to secure desired combinations of the 10, 20, 30, 40 mcs and harmonics of the 90 mc amplifier. These are obtained in the following manner.

$2 \times 90 + 20 = 200 \text{ mcs}$	$3 \times 90 + 20 = 290 \text{ mcs}$
$2 \times 90 + 30 = 210 \text{ mcs}$	$3 \times 90 + 30 = 300 \text{ mcs}$
$2 \times 90 + 40 = 220 \text{ mcs}$	$3 \times 90 + 40 = 310 \text{ mcs}$
$3 \times 90 - 40 = 230 \text{ mcs}$	$4 \times 90 - 40 = 320 \text{ mcs}$
$3 \times 90 - 30 = 240 \text{ mcs}$	$4 \times 90 - 30 = 330 \text{ mcs}$
$3 \times 90 - 20 = 250 \text{ mcs}$	$4 \times 90 - 20 = 340 \text{ mcs}$
$3 \times 90 - 10 = 260 \text{ mcs}$	$4 \times 90 - 10 = 350 \text{ mcs}$
$3 \times 90 - 0 = 270 \text{ mcs}$	$4 \times 90 - 0 = 360 \text{ mcs}$
$3 \times 90 + 10 = 280 \text{ mcs}$	$4 \times 90 + 10 = 370 \text{ mcs}$

Thus the range of 200 to 370 mcs is covered with a frequency available every ten megacycles.

2-60. SPECTRUM AMPLIFIER. The output of the mixer, V-503, is generally not a single frequency, as noted above, since undesired components generally exist in the plate circuit also. In order to discriminate against these and to increase the strength of the desired component, the mixer output is amplified in a

selective amplifier consisting of two 6J4's, V-504 and V-505, and the tuned tank circuits Z-501, Z-502 and Z-503. These tank circuits are ganged together and tuned in 10 megacycle increments by the "H" shaft. The latter is driven directly by the decade frequency control since no trimming for the one megacycle steps is desired.

2-61. Design of the spectrum amplifier is very similar to that of the main receiver amplifier except that the tuning range is 200 to 370 mcs, corresponding to the receiver frequency range of 225 to 400 mcs.

2-62. TRANSMITTER MIXER. The transmitter mixer, V-506, is used to combine the output of the Spectrum Amplifier and the 20 - 30 MC I-F Amplifier to obtain output frequency in the 225 to 400 mc range. The output of the Spectrum Amplifier is coupled into the cathode circuit of the 6J4 mixer, V-506. The output of the 20 - 30 MC I-F Amplifier is coupled to the grid of this tube. The grid is bypassed for the ultra high frequencies by means of capacitor C-534, which is small enough to present sufficient impedance for the 20 - 30 mc energy. The grid is thereby well grounded for uhf so that the 200-370 mc energy does not couple capacitively into the output circuit. The latter is tuned to the sum frequency covering the range of 225 - 399.9 mcs.

2-63. TRANSMITTER PREAMPLIFIER. Output of the transmitter mixer is amplified in the selective amplifier consisting of tubes V-507 and V-508 and the tuned tank circuits Z-504, Z-505 and Z-506. The 6J4 tubes are used as grounded grid amplifiers very similar to the main receiver amplifier and cover the same frequency range of 225 to 399.9 mcs. The tank circuits are ganged together by spur gears and driven by the "I" shaft. The latter is controlled primarily by the decade dial of Radio Set Control C-626/ARC-27 but is also trim-tuned for one megacycle steps by the unit dial. A mechanical differential adds the shaft positions of these two controls.

2-64. THEORY OF OPERATION OF TRANSMITTER. (See figure 2-8.)

2-65. FIXED I-F AMPLIFIER AND AUDIO. This subassembly includes the 3.45 mc oscillator and the 5.7 - 4.8 mc i-f amplifier which are used in the frequency generation system.

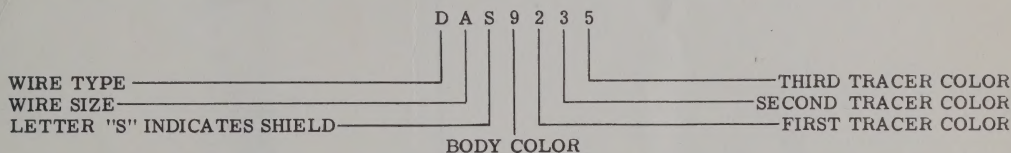
2-66. 3.45 MC OSCILLATOR. The fixed frequency oscillator which forms the starting point for the transmitter frequency consists of the triode V-306B operated as a Colpitts oscillator with the cathode above ground for r-f and the plate bypassed to ground. The capacitors C-330 and C-331 form the capacitive divider. Output from the oscillator is coupled from the cathode to the cathode of the mixer tube V-305B. This oscillator is operated only in the transmit position with plate current supplied through the power transfer relay K-901.

2-67. The grid of mixer tube V-305B is also excited by output from the oscillator V-306A which operates in the frequency range of 9.15 to 8.25 mcs.

SECTION VI
DIAGRAMS

6-1. WIRE CODE LEGEND.

6-2. In the following diagrams, the designation on the various wires conforms to the following legend.



WIRE TYPE
A AN-J-C-48 WIRE
B BUSBAR, ROUND TINNED COPPER
C JAN TYPE WL (600 VOLTS)
D MINIATURE JAN WIRE (300 V)
R JAN TYPE SRIR (1000 VOLTS)
V JAN TYPE SRHV (2500 VOLTS)

WIRE SIZE
A NO 22 AWG
B NO 20 AWG
C NO 18 AWG
D NO 16 AWG
E NO 14 AWG
F NO 12 AWG
G NO 10 AWG
H NO 8 AWG

COLOR
0 BLACK
1 BROWN
2 RED
3 ORANGE
4 YELLOW
5 GREEN
6 BLUE
7 VIOLET-PURPLE
8 GRAY
9 WHITE

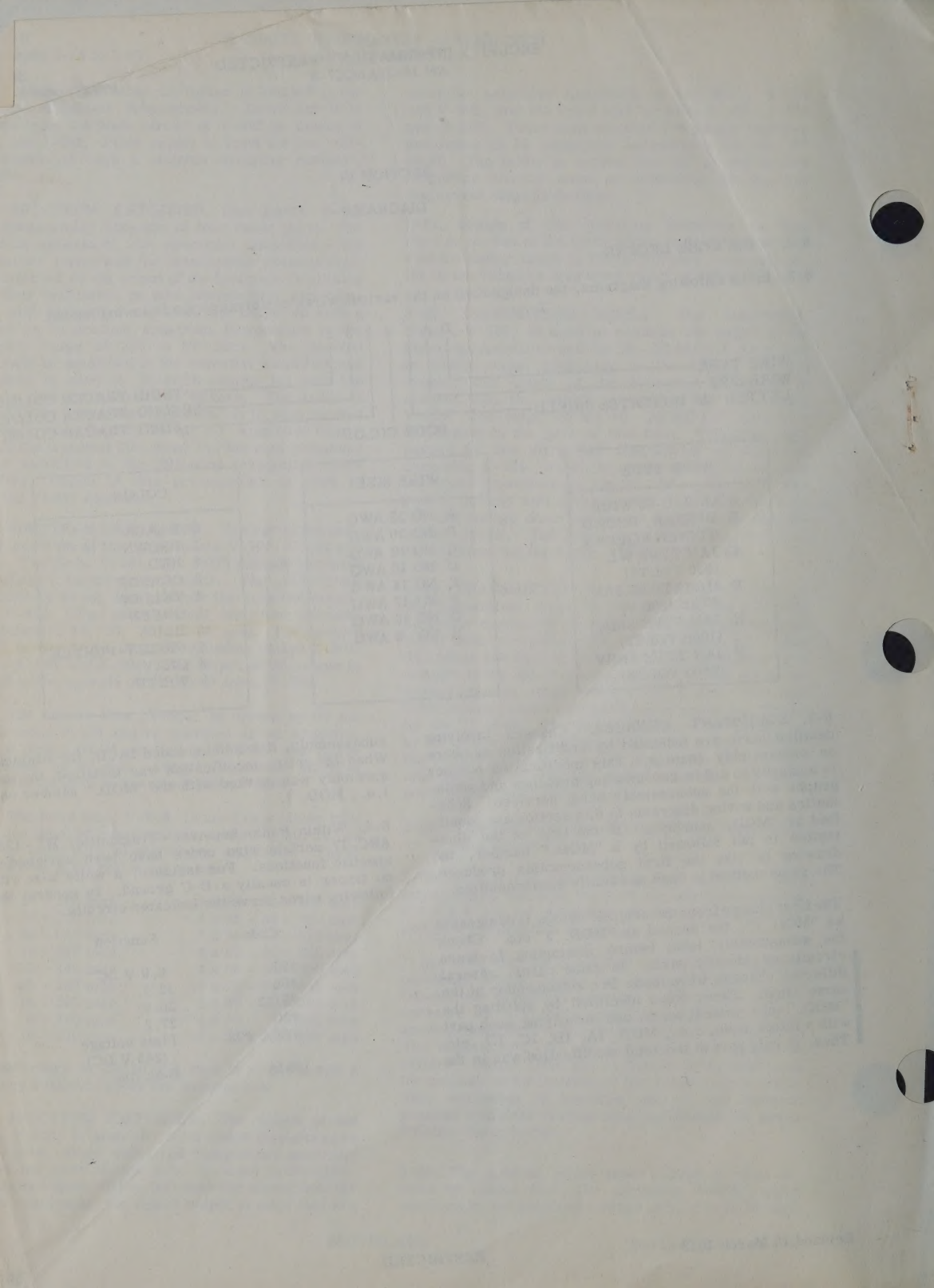
6-3. EQUIPMENT CHANGES. Changes involving detailed parts are indicated by modification numbers on subassembly chassis. This modification number is assigned to aid in coordinating drawings and photographs with the subassembly being serviced. Schematics and wiring diagrams in this section are identified by "MOD." numbers. If the title of the illustration is not followed by a "MOD." number, the drawing is like the first subassemblies produced. The same method is used to identify subassemblies.

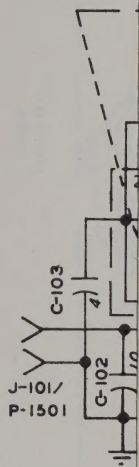
The first change from the original design is designated as "MOD. 1", the second as "MOD. 2" etc. Check the subassembly label before attempting to trace circuits or identify parts. In some cases, several different changes were made in a subassembly at the same time. These were identified by splitting the "MOD." into several parts, and identifying each part with a letter code, i.e., MOD. 1A, 1B, 1C, 1D, etc. Thus, if only part of the total modification was in the

subassembly, it would be coded 1ACD, for example. When the entire modification was installed, the subassembly was marked with the "MOD." number only, i.e., MOD. 1.

6-4. Within Radio Receiver - Transmitter RT-178/ARC-27 certain wire codes have been assigned to specific functions. For instance, a white wire with no tracer is usually a D-C ground. In general the following wires serve the indicated circuits.

Code	Function
#91	6.9 V DC
#95	13.7
#9123	20.6
#90	27.5
#92 & #93	Plate voltage (245 V DC)
#915	Bias line





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Figure 6-2. Receiver-Transmitter

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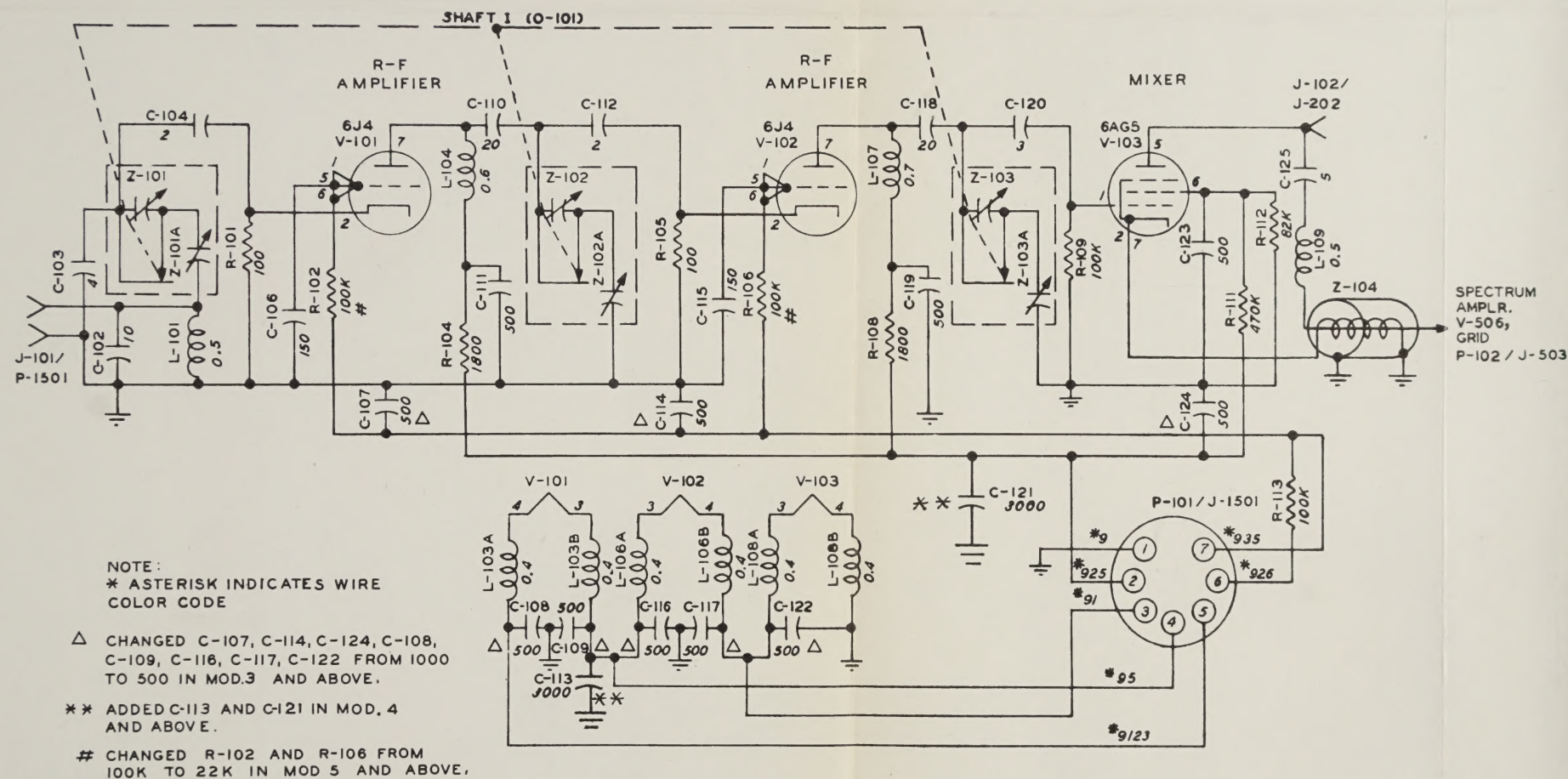
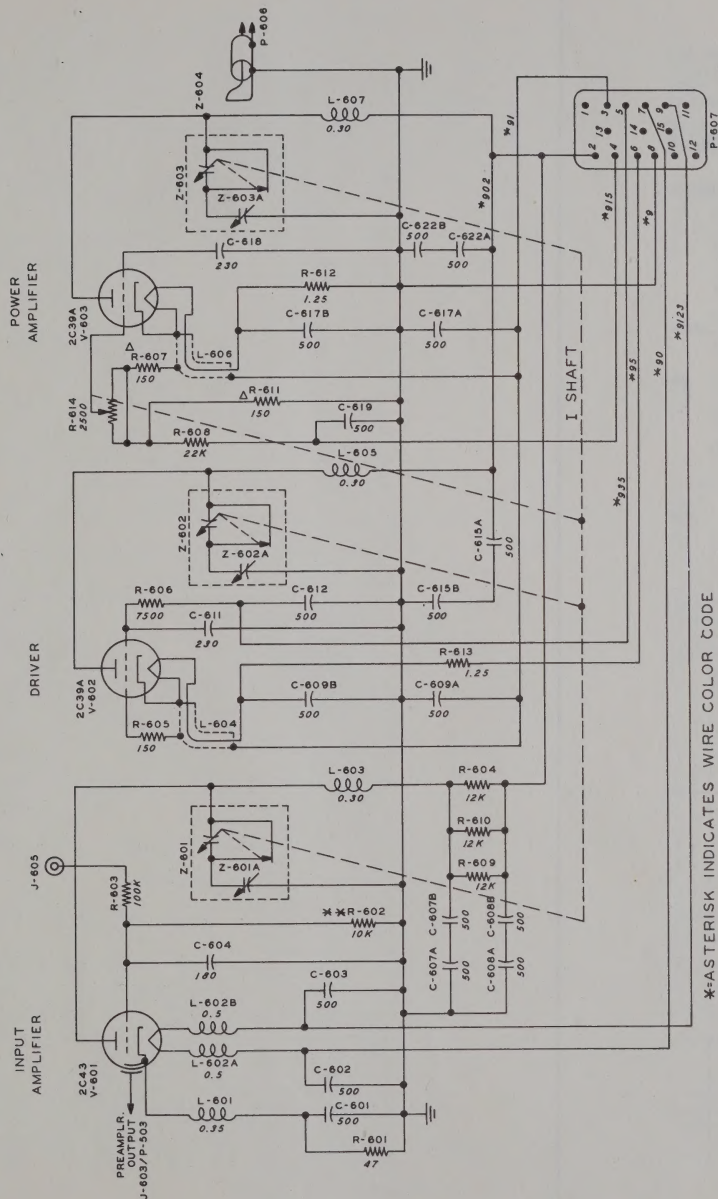


Figure 6-2. Receiver-Transmitter RT-178/ARC-27, Main Receiver R-F Amplifier Subassembly, Schematic, (Original, Mod. 3, 4 and 5)

RESTRICTED



*-ASTERISK INDICATES WIRE COLOR CODE
 ** CHANGED TO 2200 IN MOD. 2C AND ABOVE.
 Δ VALUE OF R-607 AND R-611 CHANGED FROM
 150 TO 470 IN MOD 2E AND ABOVE.
 MOD. 2A, 2B & 2D DO NOT AFFECT THE SCHEMATIC DIAGRAM

Figure 6-8A. Receiver-Transmitter RT-178/ARC-27, Power Amplifier Subassembly, Schematic (Mod. 1, 2)

WIRE COLOR CODE.

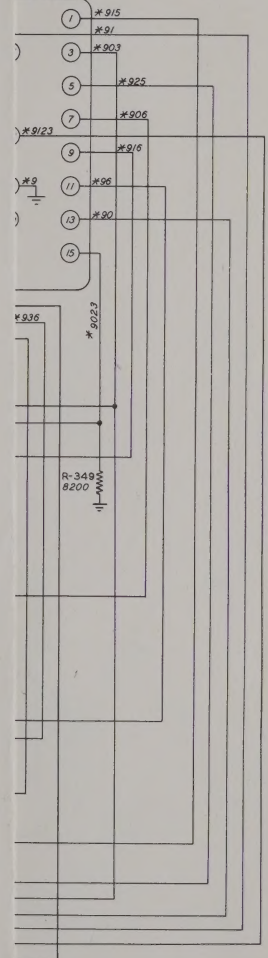
341 AND R-342

4 MOD. 2 AND ABOVE.

TE C-383 IN MOD. 3

2K TO 4700 IN MOD 4A & ABOVE.
BE TYPE 5726 TO V-310 AND
D ABOVE.

12 / J-1502



1. The following information is being furnished to you for your information only. It is not to be used for any other purpose.

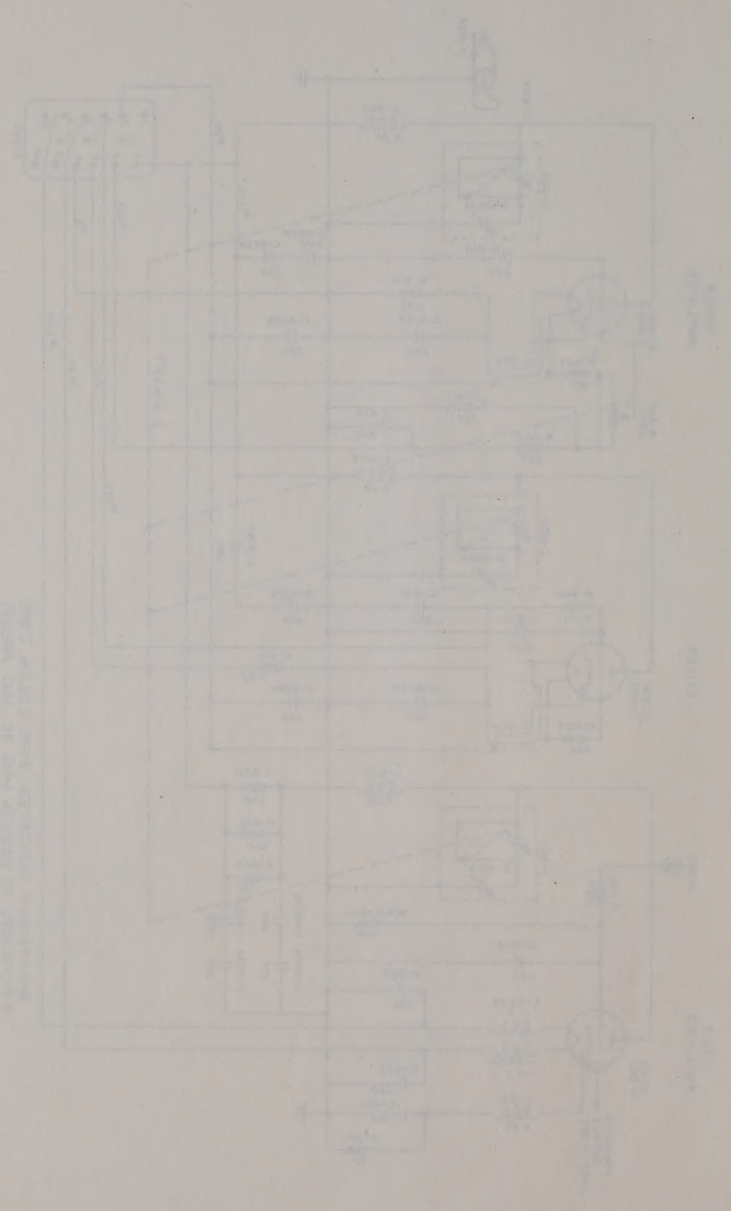
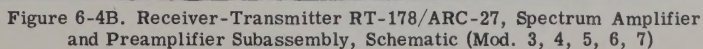
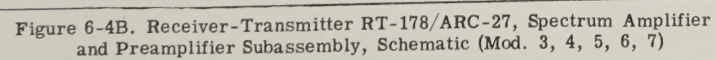


Figure 1. Block Diagram of the Electronic Circuit.



67B/68B

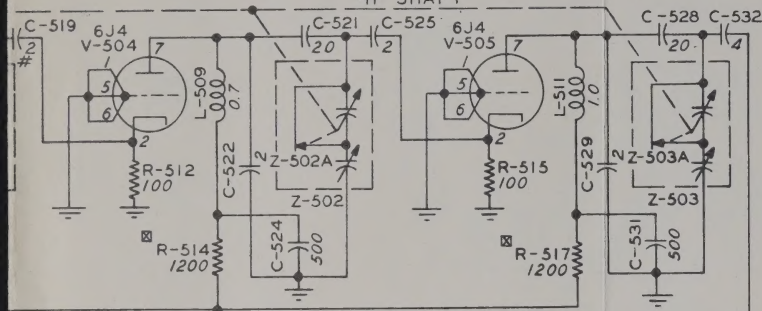


67B/68B

SELECTIVE AMPLIFIER

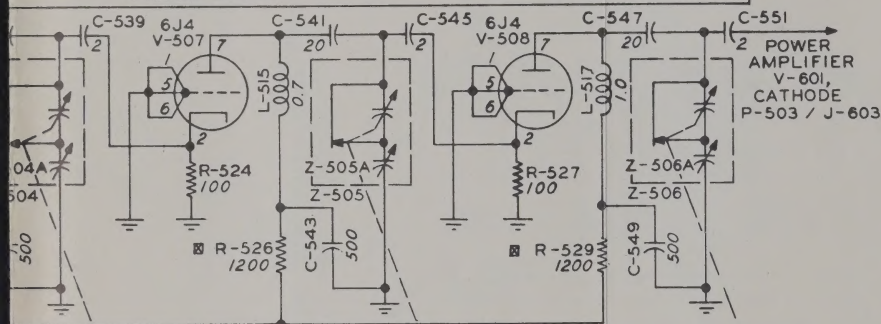
SELECTIVE AMPLIFIER

"H" SHAFT



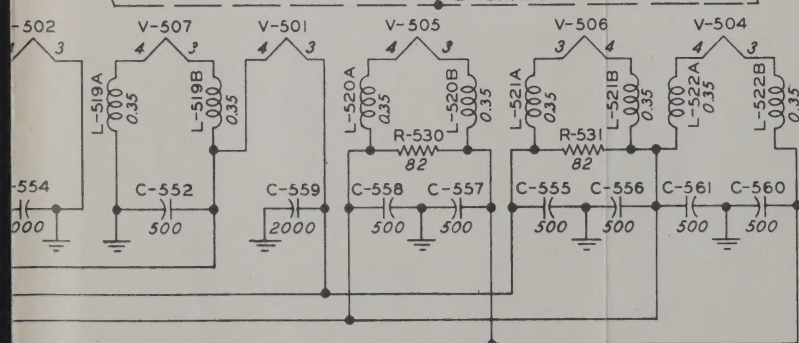
TRANSMITTER PREAMPLIFIER

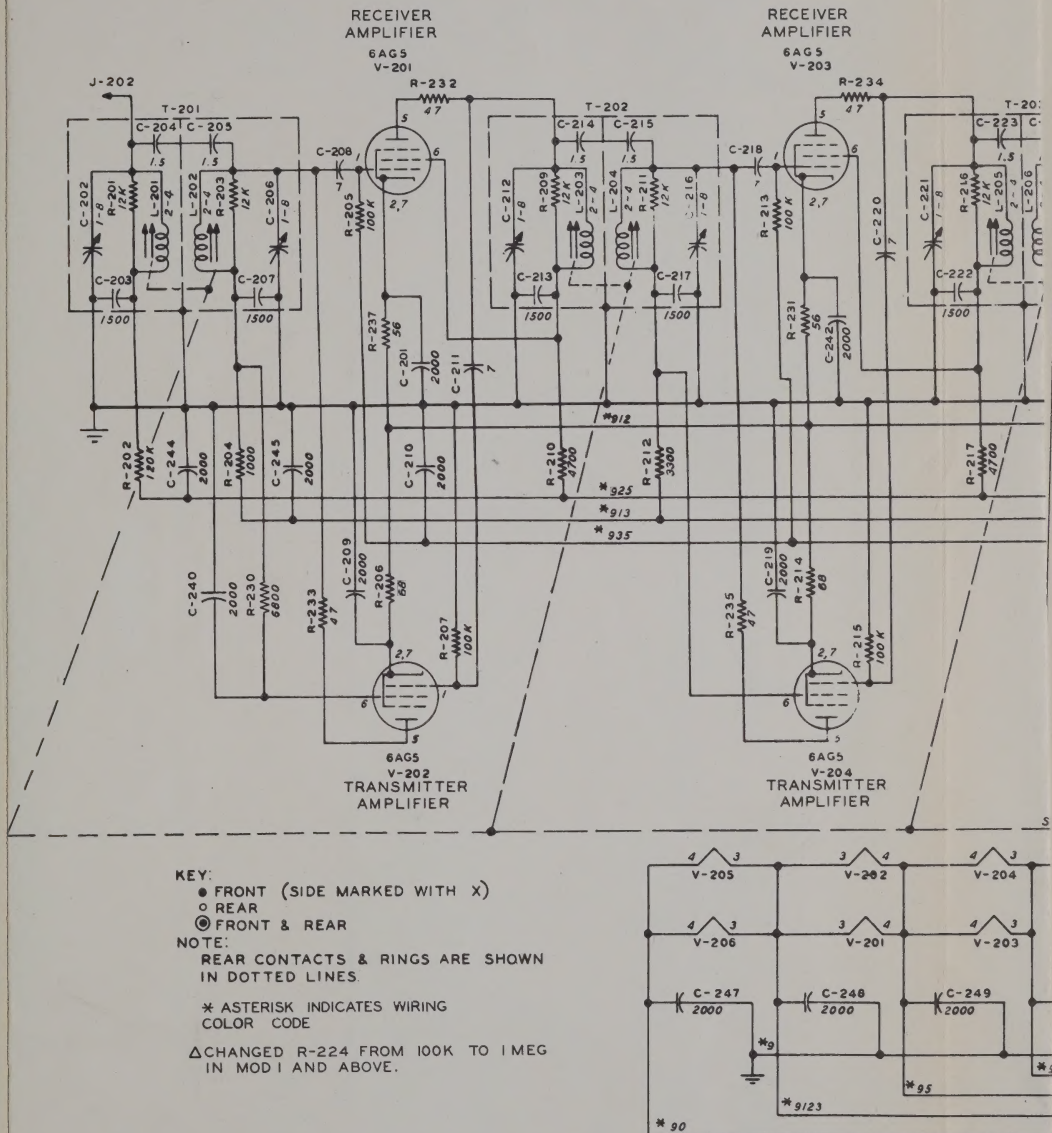
TRANSMITTER PREAMPLIFIER



POWER
AMPLIFIER
V-601,
CATHODE
P-503 / J-603

"I" SHAFT





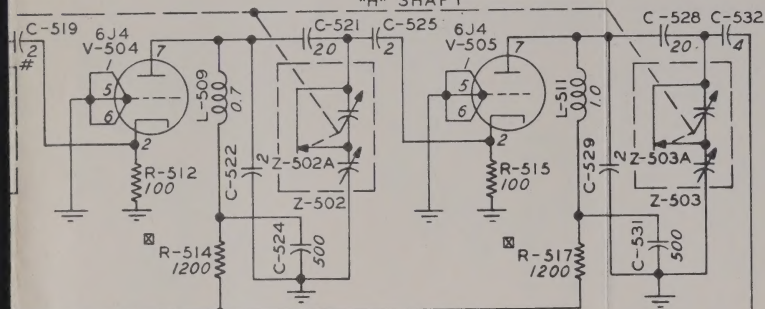
5. Receiver-Transmitter RT-178/ARC-27, 20-30 MC I-F Amplifier Subassembly, Schematic, (Original and Mod. 1, 2)

RESTRICTED

SELECTIVE AMPLIFIER

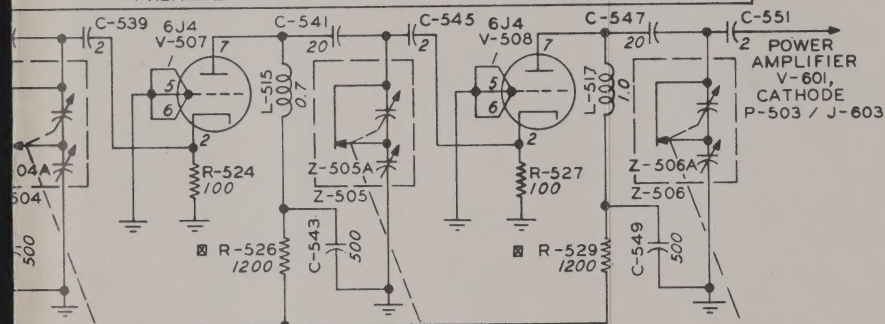
SELECTIVE AMPLIFIER

"H" SHAFT



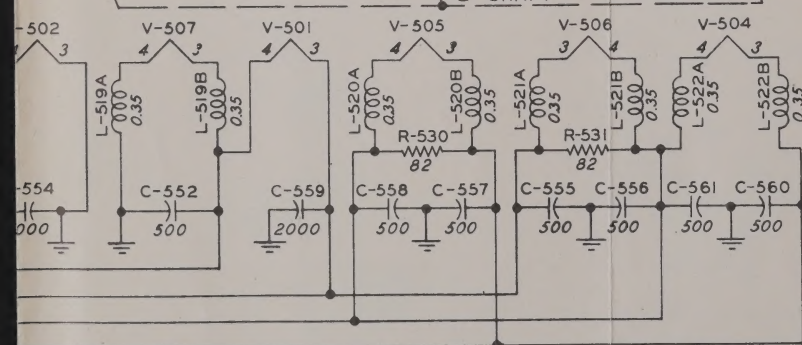
TRANSMITTER PREAMPLIFIER

TRANSMITTER PREAMPLIFIER



POWER
AMPLIFIER
V-601,
CATHODE
P-503 / J-603

"I" SHAFT



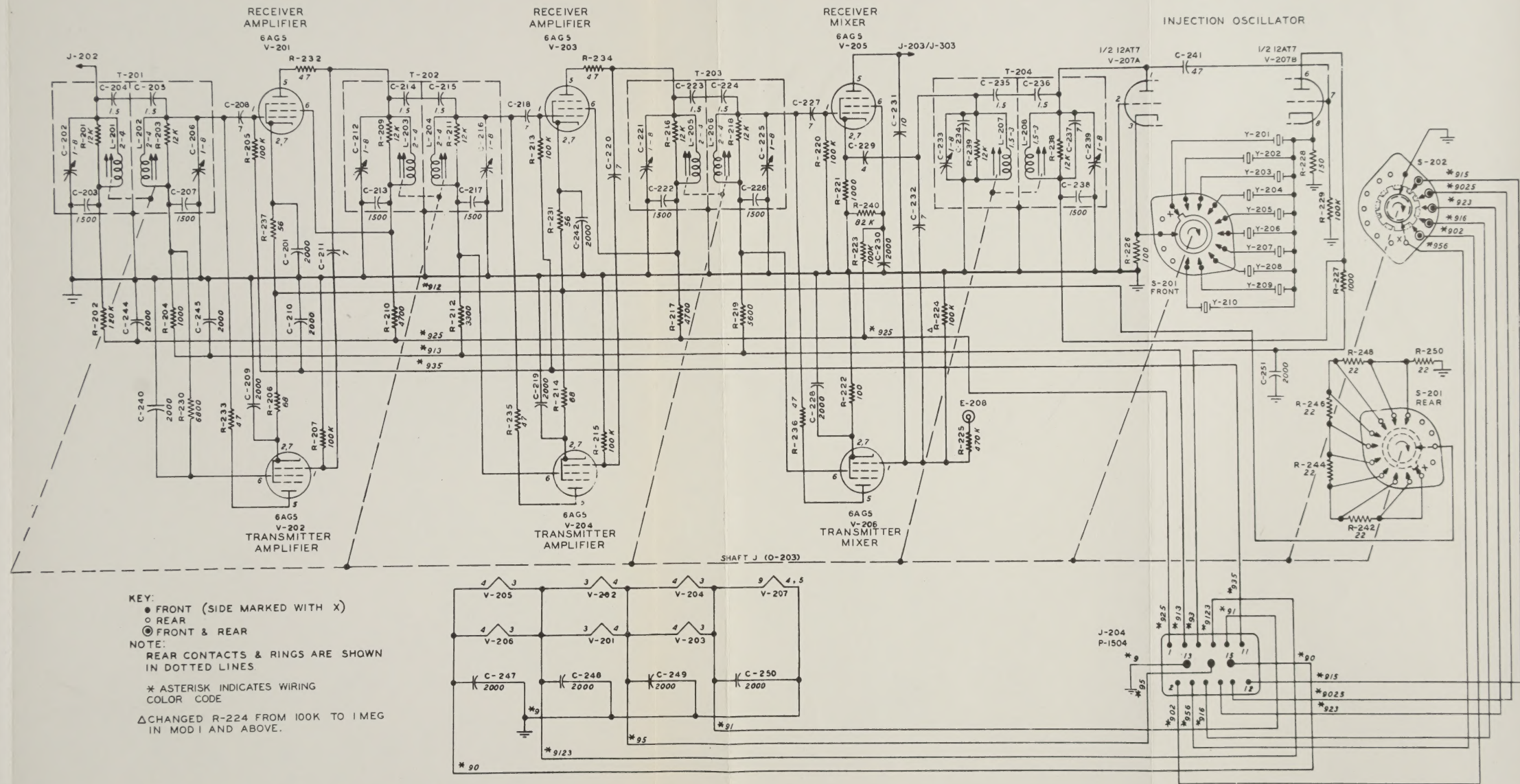


Figure 6-5. Receiver-Transmitter RT-178/ARC-27, 20-30 MC I-F Amplifier Subassembly, Schematic, (Original and Mod. 1, 2)

RESTRICTED

NOTE.
ITEMS MARKED WITH AN ASTERISK (*)
INDICATE WIRE COLOR CODE.

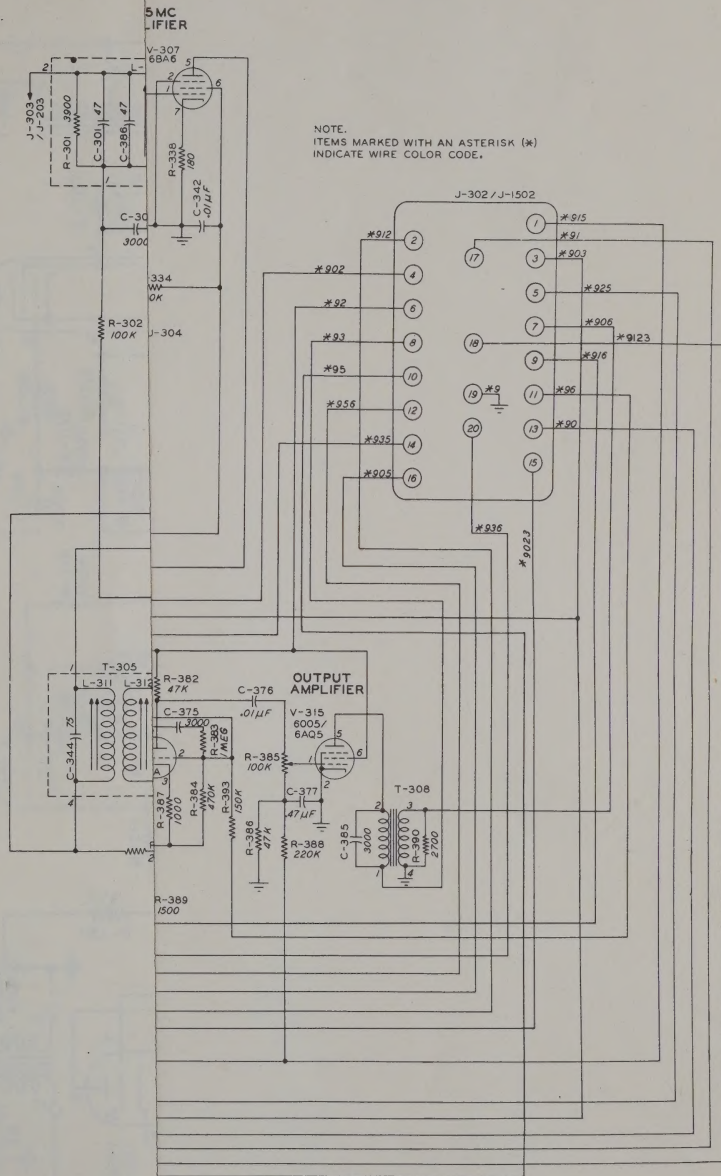
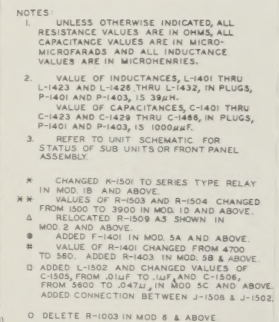
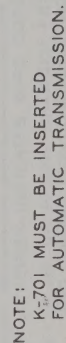


Figure 6-6C. Rec
Amp



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73B

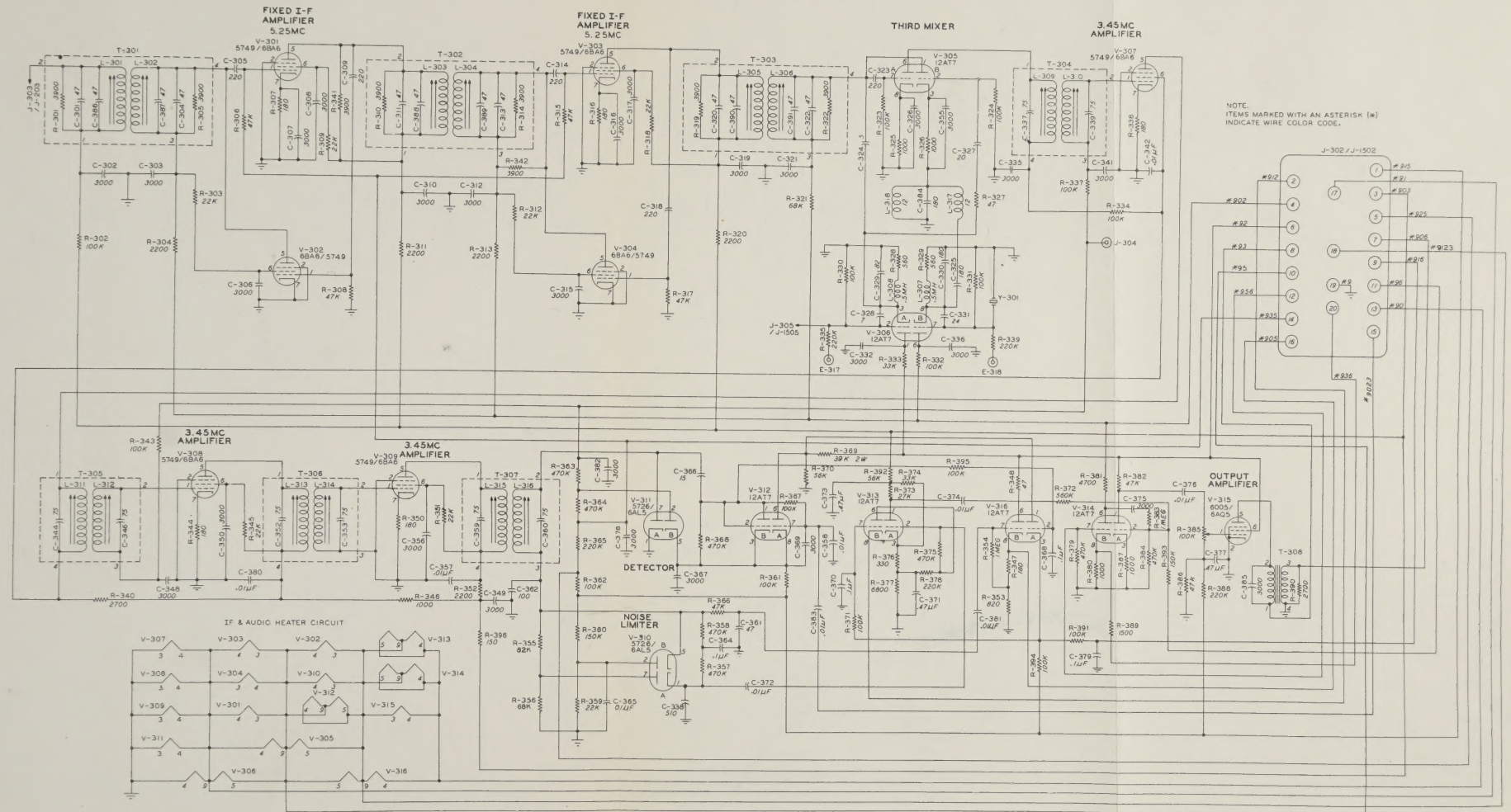


Figure 6-6C. Receiver-Transmitter RT-178/ARC-27, I-F and Audio Amplifier Subassembly, Schematic (Mod. 6)

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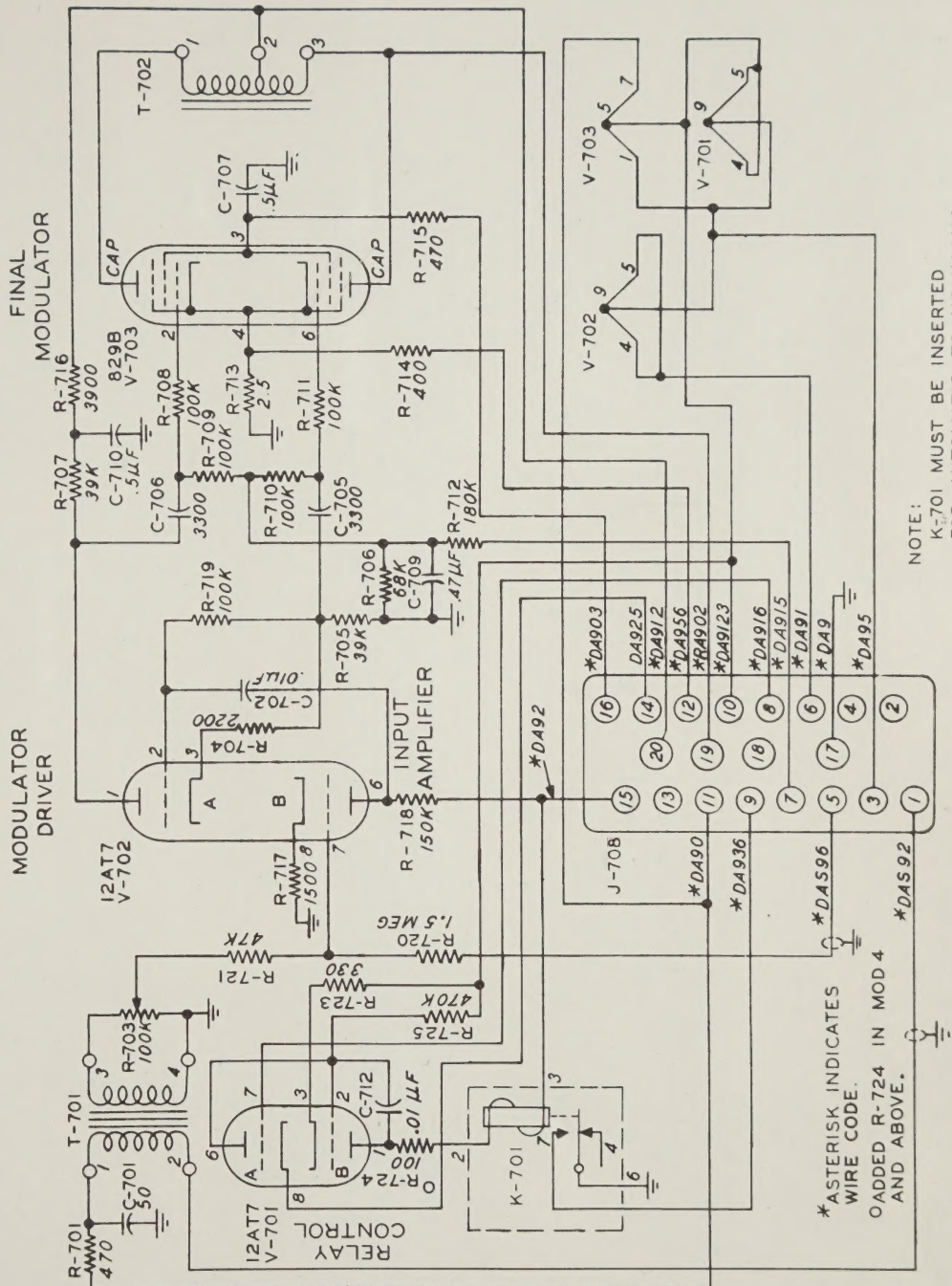


Figure 6-7B. Receiver-Transmitter RT-178/ARC-27, Modulator Subassembly Schematic (Mod 3, 4)

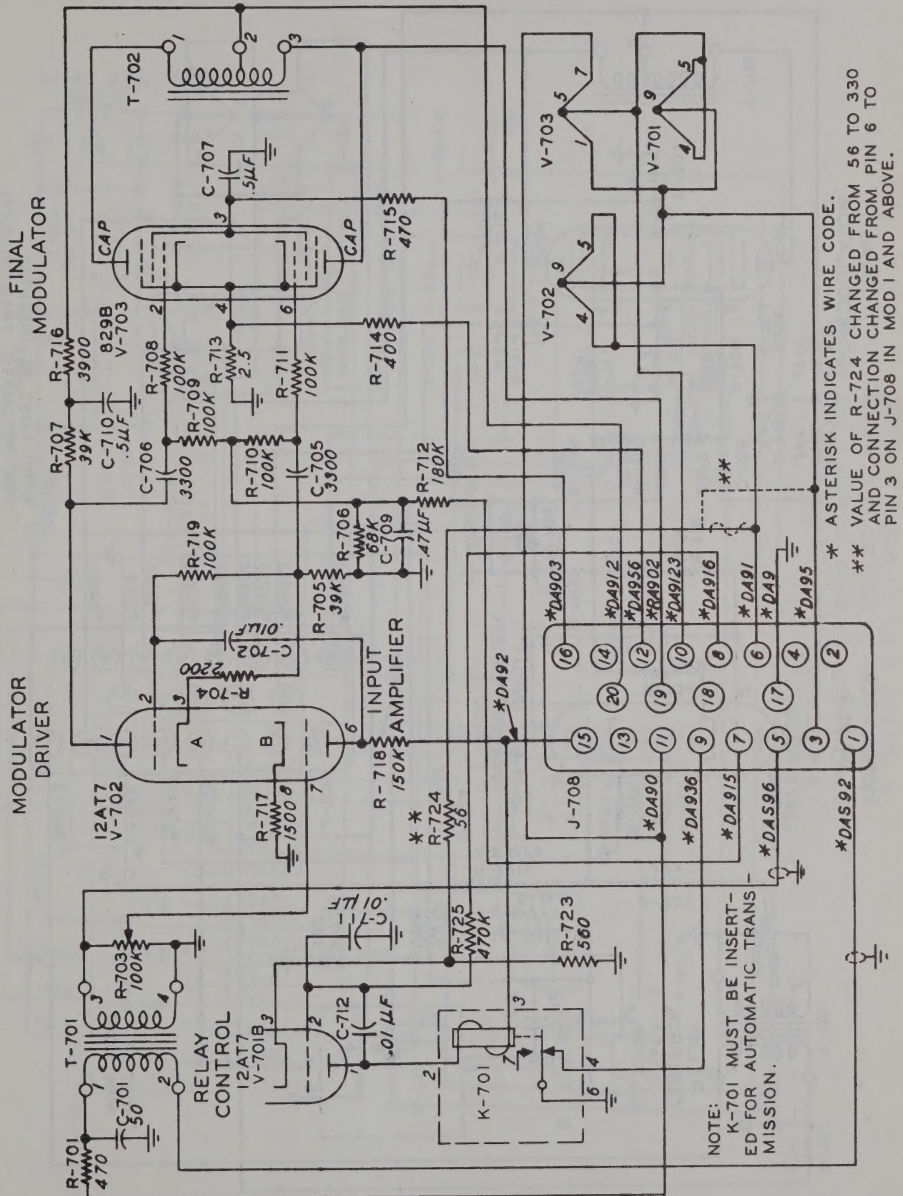


Figure 6-7. Receiver-Transmitter RT-178/ARC-27, Modulator Subassembly Schematic (Original and Mod. 1, 2)

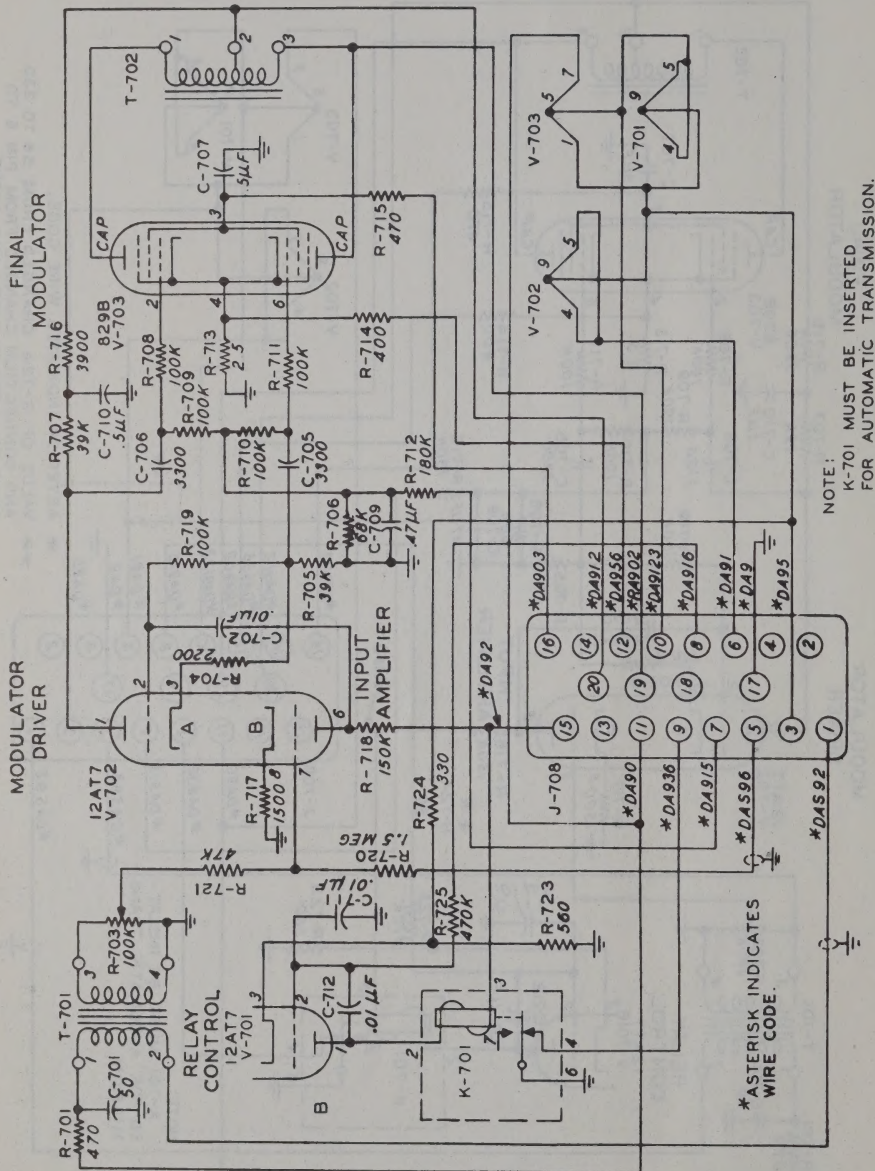
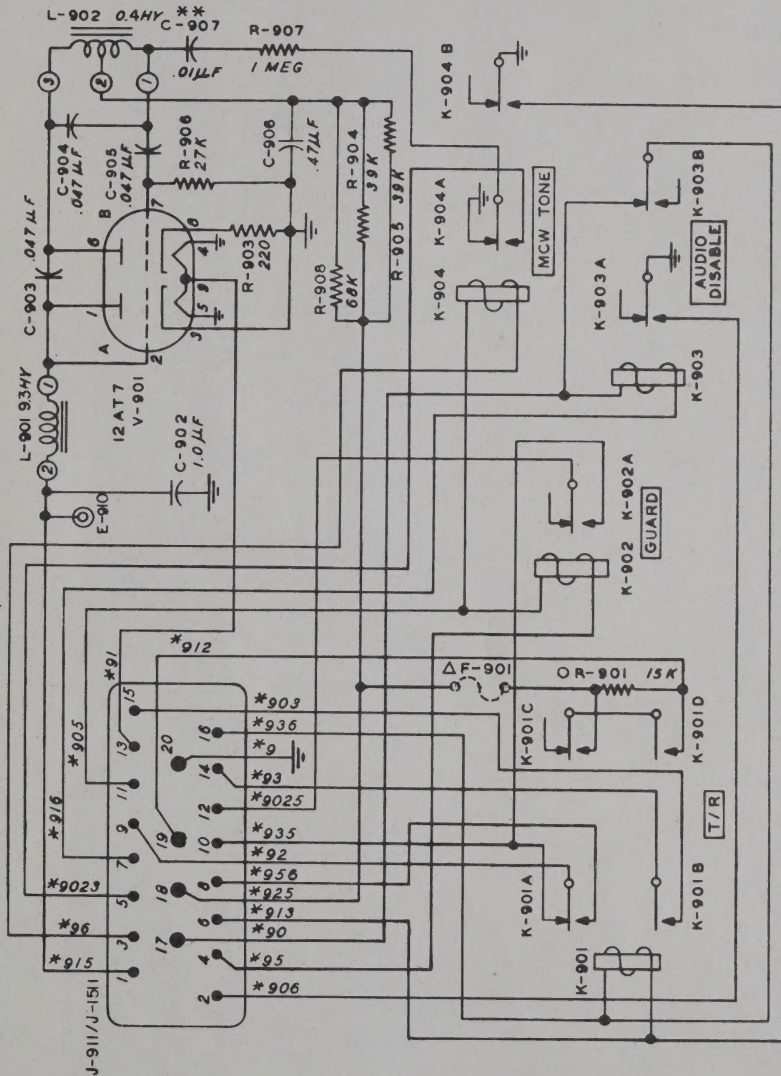
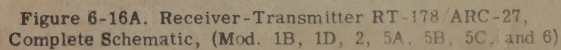


Figure 6-7A. Receiver-Transmitter RT-178/ARC-27, Modulator Subassembly Schematic (Mod.2)



NOTE:
 * ASTERISK INDICATES COLOR CODE.
 ** CHANGED TO 3000 IN MOD 1 AND ABOVE.
 Δ ADD F-901 IN MOD. 2C AND ABOVE.
 O DELETE R-901 IN MOD. 3 & ABOVE.

Figure 6-9. Receiver-Transmitter RT-178/ARC-27, Bias Relay Subassembly, Schematic, (Original, Mod. 1, 2, 3)



91A/92A

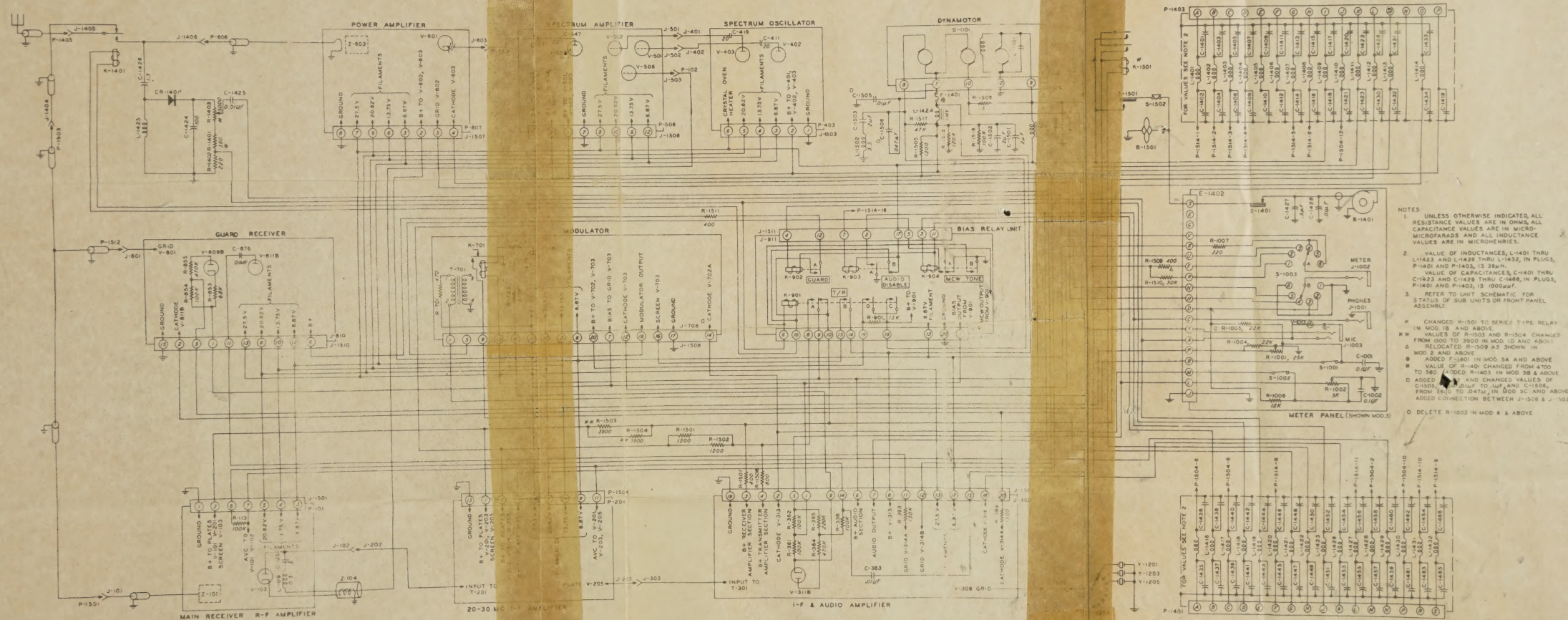


Figure 6-16A. Receiver-Transmitter RT-178 ARC-27,
Complete Schematic, (Mod. 1B, 1D, 2, 5A, 5B, 5C, and 6)

RESTRICTED

91A 92A

